RG104 entry 217 box 1

Assayer's Office, U.S. Mint,
June 8th 1864

Hon. James Pollock
Director &c. &c.
Dear Sir,

A few weeks since, you placed in my hands a bar of Aluminum-Bronze, with two letters, from the Secretary of the Treasury, and from Prof. Joseph Henry (writing on behalf of a Committee of the National Academy), requesting certain manipulations to be made, with a view to testing the properties of that alloy; specially with reference to its use for coinage.

The proportion of the alloy was not stated; but I found it to contain 9.8 per cent of aluminum, and have no doubt it was intended for copper 90, aluminum 10. The specific gravity I found to be 7.63.

The original bar was melted and cast into a cent-ingot; the melting required about the same temperature as for tin-bronze. It did not turn out a clean smooth bar, apparently from the oxide preventing a smooth flow in contact with the mould.

In the process of rolling, this ingot was compared with one of our cent bronze, (95 copper,

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3 tin, 2 zinc.) The circumstances of rolling and annealing being the same, on the fifth passage through the rolls the Aluminium-Bronze had become so rigid and unyielding, and cracked to such a degree, as to prevent further operation; whilst the other was continued to the guage required for the cent planchet. At the fifth rolling, the al.-br. became detached in plates of oblique fracture (as will be seen by a specimen) similar to overheated brass.

The strip of al.-br. was then remelted, and annealed at every third passage through the rolls. It required seven annealings to reduce it to the cent guage.

When at the thickness of one-tenth inch, it took a portion, as directed, to be drawn into wire. To avoid injuring the texture, the piece was sawed out.

To draw a wire of the al.-br. from $\frac{1}{10}$ inch diameter, down to $\frac{1}{20}$ inch, required twenty-one draughts, and four annealings.

To draw a wire of pure copper, in the same terms, required seven draughts, and no annealing after the initial one.

Cent planchets were next cut out of the rolled ingot, and were annealed and pickled. In annealing to a low red heat, there was hardly any difference as to resisting oxidation, compared with the tin-bronze. In pickling, two dips were

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used; the first with dilute sulphuric acid, and the second with ~~with~~ nitric acid of 26 B. The planchets were gauged to the thickness of the present bronze cent. Their average weight was about 39 grains, while that of the tin-bronze is 48 grains.

A small number of pieces was then struck, in two ways: with the steam-press, and with the lever press. In both cases it required unusual force. The head-workman who managed the striking of the lever press, and from whom the best specimens were expected, remarked after he was done — "I can do nothing with that metal" — meaning that he could not bring up the impression. This will be seen by examining the specimens.

The final experiment, as to the power of a coin of this alloy to resist wear or abrasion, was made at the special request of Prof. Henry, and in the manner suggested by him. Ten coins of the legal tin-bronze, ten of pure copper, and ten of the aluminum-bronze, were first weighed by parcels, then placed in three boxes, and the boxes set in the agitator, used in the humid assay. They were then shaken, at the rate of about 250 movements in a minute, (counting the up-and-down as one shake,) for three hours. They were then taken out, the dust wiped off, and weighed. This operation was repeated for another three hours, and the weight again taken. The coins being much battered (as

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will be seen) and having undergone about 90,000 shakes, this was considered sufficient. The results were as follows. (The copper planchets were drawn about 3½ grains light, but this does not affect the experiment.)

Kinds of Coin.	First Weight. Grs.	Second Wt. Grs.	Third Wt. Grs.
Legal Bronze	482.4	482.0	481.7
Pure Copper	445.2	444.3	443.7
Aluminium-Bronze	387.5	387.3	387.3

This is an interesting experiment, as showing the relative hardness and firmness of those metals or alloys.

It seems superfluous to say, that there is a great variety in the kinds of wear, and that a coin is best tried by the kind of treatment to which it is usually subjected. The kind of attrition just dwelt upon, has been several times suggested here, in the course of years, so that it seems to be a natural first thought. Yet in point of fact, coins are rarely submitted to such an ordeal, except that they are occasionally poured from one bag or box into another. The real wear of a coin is a composition of such particulars as these: the gentle rubbing of the human hand, searching out the table as well as the raised parts of the coin; the action of unctuous and saline excretions of the hand;

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and the more active chemical agencies which are met with in the market-stalls, and in the slops of a counter in a beer saloon.

One of the aluminium-bronze coins was carried for a few hours in the closed hand (a clean hand, but of course perspirative,) and in that time was utterly tarnished, as will be seen by the specimen sent.

I am not called upon to discuss the other aspects of aluminium coinage, and shall only say in conclusion, that while the unalloyed metal possesses some very desirable properties (supposing it were cheap enough) for coinage, the aluminium-bronze seems to have no fitness in any respect.

Next to a tractable alloy, and one that is agreeable to sight and touch, it is of all things desirable to have something that will not quickly or greatly tarnish. This, it must be owned, is hardly to be hoped for, among the inferior metals, and it is well known that even standard silver will become foul and discolored. Since these experiments have been concluded, I have been turning my attention to the binary alloys of copper and tin, with a view to find some proportion that would better resist tarnish than the new coinage, or any that has

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preceded it, and at the same time be sufficiently ductile. Such an alloy would be especially serviceable for a system of tokens, of five and ten cents; for I have no idea of disturbing the present mixture for the one and two-cent coins. I already feel some encouragement, and hope to be able to speak more definitely, in time for the next Annual Report of the Director of the Mint.

I send a box by Adams' Express, direct to Prof. Henry, containing the following:

No. 1, a piece cut off the ingot.
2. 3. 4., rolled, different stages.
5. Tin-bronze, rolled. (Requested by Prof. H.)
6. Coins, struck with lever press.
7. Do. do. with steam press.
8. Tin-bronze coins, after shaking.
9. Copper do. do.
10. Aluminium-br. do. do.
11. Al.-br. coin, held in the hand.
12. 13. Wire, al-br. and copper.
14. The remnants, cast into a bar (not with much care.)

Very respectfully
your obt Servant
J. R. Eckfeldt
Assayer.

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18640608 Aluminum-bronze tests

Assayer's Office, Mint of the United States
June 8, 1864

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Director of the Mint

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14	The remnants, cast into a bar (not with much care)

Very respectfully, your obedient servant,
J. R. Eckfeldt,
Assayer

* Baumé is an obsolete system of expressing concentration of a solution by its specific gravity. In this instance, "26° Baumé" is equal to nitric acid with a specific gravity of about 1.2185 and a concentration of approximately 35 percent.